FREQUENCY SYNTHESIZERS FEATURING QUARZ-CRYSTAL ACCURACY

- Precision Frequency Measuring and Recording Equipment to 20000 Mc
- Precision Signal Generators, carriers to 860 Mc with optional modulation
- Digital Signal Generators to 470 Mc suited for remote control
- Precision UHF Signal Generators, 850 Mc to 4000 Mc
- Mobile and Stationary Remote Transmitter Measuring Sets to 10000 Mc

The illustration shows a fully transistorized, portable frequency measuring set which can, in conjunction with suitable receivers, be used both as a mobile and stationary installation for the measurement of remote transmitters. Measurements can be effected in the range 10 kc to 1000 Mc (or to 12000 Mc when extended by the type FS 500), with an accuracy of $\pm$ 0.05 cps in the fundamental range to 32 Mc (or 470 Mc, respectively). The installation comprises the Universal Antenna Fader Type AB 10, the Digital Signal Generator Type FS 30, and the Frequency Measuring Oscilloscope Type CDG 15 T.

SCHLUMBERGER

PRECISION SIGNAL GENERATOR SYSTEM DO 1001

The basic unit type DO 1001 is a crystal-controlled signal generator permitting virtually any desired frequency to be set up with the same accuracy as the incorporated 1 Mc crystal oscillator. Its excellent signal-to-noise ratio for non-harmonics and for FM-noise permits the direct use of the output signal of this frequency synthesizer for critical applications in receiver and filter engineering. The required constant output level is achieved by means of an electronically controlled wideband amplifier which compensates any variations of load, supply voltage and/or frequency.

Frequency range: 50 kc to 52 Mc
Phase locked: at 10 kc intervals
Continuous tuning accuracy: $\pm$10 cps (dial points: 50 cps)

Crystal standard: 1 Mc (proport. oven control)
Short-term stability: 2 parts in 10^8 over 5 hrs.
Long-term stability: 2 parts in 10^7 over 30 days

Output signal: 1 volt RMS max. (int. imp. 50 ohms $\pm$1%)
Stability of level: $<\pm$0.1 db (between no-load and short-circuit)
Distortion factor: approx. 1%

Spurious modulation:
AM: 80 db down
FM: 70 db down (below 10 kc deviation)

Noise level: $<$ 80 db down

The space above the Type DO 1001 is designed to house modulator units and additional oscillator sub-units for extending the frequency range to 860 Mc. Depending on the program of applications, a variety of combinations can be selected in order to optimally suit the specific purpose. Subsequent modifications or extensions are possible at any time. Listed below are some of the more usual combinations and suitable accessories.

Modulator Unit Type AF 50 + C 50. Serves for amplitude and frequency modulation of the DO 1001-signal in the fundamental range 50 kc to 52 Mc.

AM: Modul. frequency,
internal: 1 kc (sine or square wave)
external: 30 cps to 100 kc (sine)
300 cps to 10 kc (square)
Modulation depth: 0 to 99% (meter indicator)
Modulation distortion: $<$ 2% (for 70% AM)
Parasitic phase modul.: $<$ 2% (for 70% AM)

FM: Modul. frequency,
internal: 1 kc (sine or square)
external: 30 cps to 100 kc (sine)
50 cps to 10 kc (square)
FM-deviation: 0 to 200 cps . . . 100 kc (9 ranges) (meter indicator)
Modulation distortion: $<$ 0.5% (60 cps to 20 kc)
Parasitic AM: $<$2% (for 100 kc FM-deviation)

Modulator Unit Type AF 50 + V 500 P + 0 250
(see illustration)

This is the most widely used combination of extension sub-units offering

AM: from 50 kc to 860 Mc
FM: from 50 kc to 860 Mc
pulse and video: from 27 Mc to 860 Mc

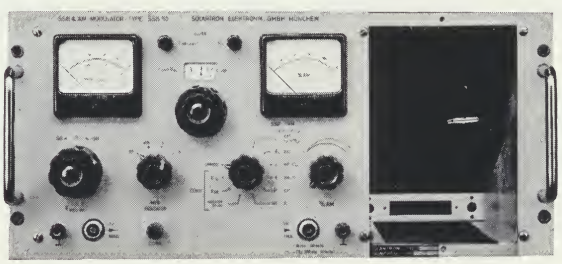
with additional space for oscillator sub-units 0 250, 0 500 and 0 800.

AM/FM: Specifications as for Type AF 50 + C 50
P(A)M: Bandwidth: 0 to 6 Mc (—3 dbs)
Rise time: approx. 80 nanosec.
Overshoot: $<$ 5%

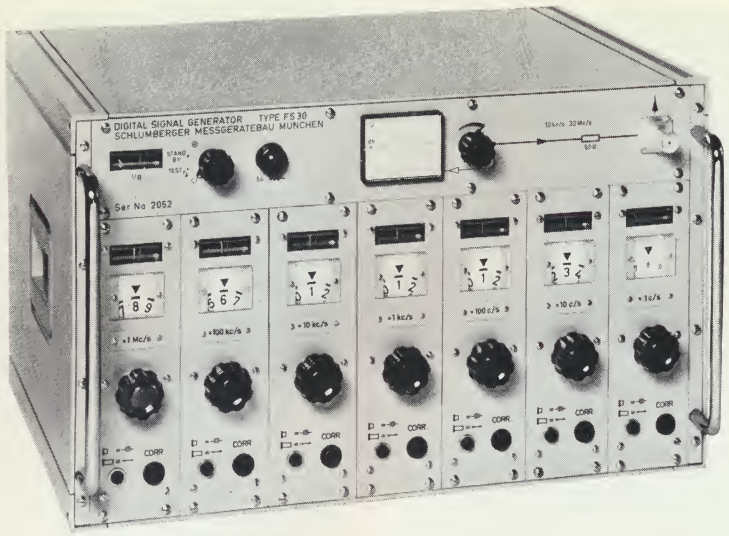
Modulator Unit Type AF 50 + V 500 TV + 0 250
This corresponds largely to the above described combination but is particularly suited for TV modulation and comprises an additional clamping circuit.

AM/FM: Specifications as for Type AF 50 + C 50
TV Mod.: Bandwidth: 10 cps to 6 Mc (—1 db)
Rise time: 60 nanosec.
Overshoot: $<$ 5%
Differential gain: $<$15%; adjusted approx. $\pm$ 6%
Differential phase: $<\pm$ 6°

Modulator Unit Type SSB 50
This unit generates simultaneously with the 50 kc to 52 Mc output signal of the Type DO 1001 a synthetic sideband which can be shifted by $\pm$10 kc. In addition an amplitude modulation of symmetrical sidebands can be provided and the modulating frequency corresponds to the tuned difference between carrier (DO 1001) and sideband (SSB 50).
SSB: Type of modulation: synthetic sideband
Sideband spacing: 0 to $\pm$10 kc (continuously tunable)
Indicator: frequency meter 0 to 0.5 . . . 15 kc (4 ranges)
Suppression of carrier: 0 to 50 dbs.
Intermodulation: $<$ — 40 dbs.
AM: Modul. frequency, internal: 0 to 15 kc
external: 30 cps to 100 kc
Modulation depth: 0 to 99% (meter indicator)



TRANSISTORIZED DIGITAL SIGNAL GENERATORS



The Digital Signal Generator Type FS 30 is a decade-type frequency synthesizer, featuring the most advanced specifications.

Type FS 30 incorporates a 1 Mc crystal oscillator housed in a proportionally controlled thermostatic oven assuring a high degree of stability. To achieve the best results a battery is built-in to provide a non-interrupted operation. Maintenance and repair of the FS 30 is largely facilitated because it consists to a wide extent of identical, interchangeable module stages. Operation, too, is quick and convenient because an automatic lock-in system omits tedious manual lock-in synchronisation of the individual stages. Low power consumption, quick readiness for operation, extremely high setting accuracy, a constant output level and versatile modulator accessories make the unit highly suitable not only for laboratory and test applications, but also for mobile field work. This is achieved by a built-in battery of a hermetically sealed type (automatically rechargeable) which takes over the power supply. Higher accuracy requirements can be met by controlling the unit from an external 1 Mc standard with negligible deterioration of the signal-to-noise ratio. Where accuracy requirements are less demanding, one or more of the decade stages may be omitted.

An accessory unit for extending the frequency range to 470 Mc is available (type FS 500).

Frequency range: < 10 kc to 32 Mc
Phase locked: at 10 cps intervals
Continuous tuning accuracy: ± 0.05 cps
Dial increments: 0.1 cps

Crystal standard: 1 Mc (oven)
Short-term stability: 3 parts in 10^9 over 24 hrs.
Long-term stability: 2 parts in 10^8 over 30 days

Output Signal: 1.3 volt RMS max. (int. imp. 50 ohms)
Distortion factor: < 2%

Noise modulation: < 90 db down

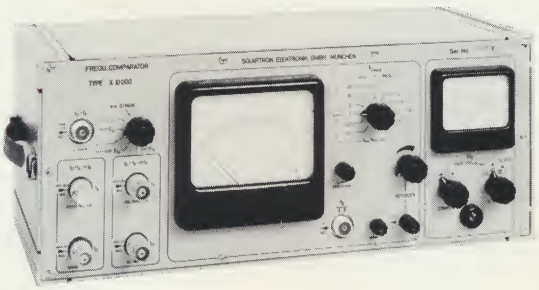
Power supply: approx. 20 VA; 5 hrs. battery operation provided

Digital Signal Generator Type FS 1 (2)
These units are largely identical with the Type FS 30 but cover a lower frequency band. Specifications differ on the following points:

Frequency range: < 300 cps (4 kc) to 1.2 (2) Mc
Continuous tuning accuracy: ± 0.005 cps
Phase locked: at 1 cps intervals
Dial increments: 0.01 cps

Output signal: 2.5 volts RMS max. (int. imp. 0/75/150/600 ohms)
Distortion factor: < 1%

UNITS FOR FREQUENCY MEASUREMENTS



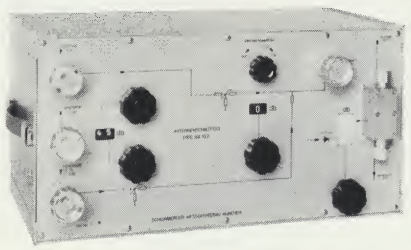
Direct Reading Frequency Meters, Types X 3, 500, 10000

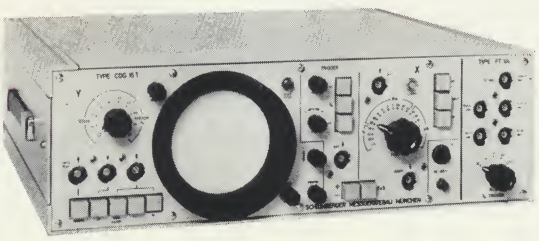
Analog indication of frequency values in the range 0 to 3 Mc with an accuracy of 0.5% f. s. d. in 10 ranges. Output of 4 V into 1000 ohms is available for driving a recorder. A second meter provides an expanded scale giving full deflection of ± 5% at selected range.

X 500: comprises harmonic mixer to 500 (1000) Mc
X 10000: comprises harmonic mixer to 10 (20) Gc

Universal Antenna Fader Type AB 10

Serves to attenuate and mix a reference signal (e. g. FS 30, FS 500) with an incoming signal to form a difference frequency in a receiver. Resistive attenuators (< 1% accuracy) from 0 to 1000 Mc; capacitive coupling loop from 500 Mc to 10000 Mc. A built-in varactor diode harmonic generator provides a harmonic spectrum to 10 (20) Gc.





Frequency Measuring Oscilloscope Type CDG 15 T

Used for measuring difference frequencies and as a panoramic display unit in remote transmitter measuring sets.

Y-amplifier: 0 to 50 Mc, from 20 mvolts/cm to 20 volts/cm
X-amplifier: 0 to 1 Mc, 0.2 volts/cm

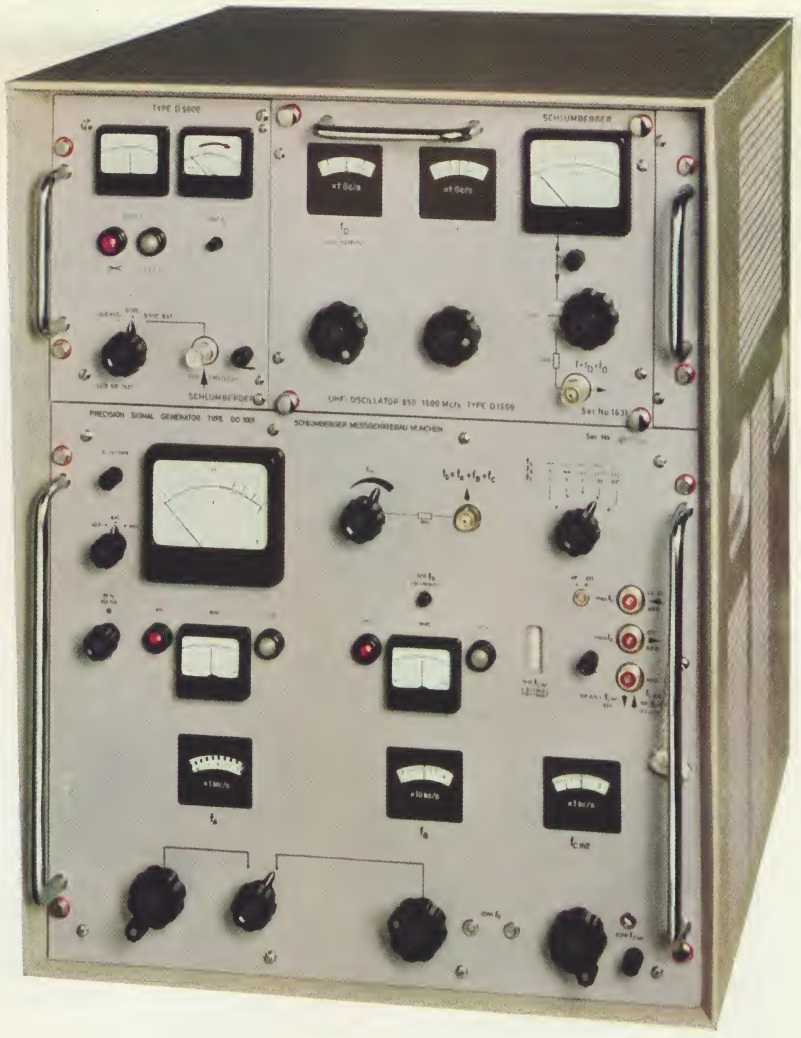
Various triggering facilities: internal, external, and by crystal frequencies.

UNITS UNDER DEVELOPMENT

Precision UHF Signal Generators

The unit designated **D 5000** serves to accommodate oscillator sub-units of three different types:

Type 0 1500:	850 Mc to 1550 Mc
Type 0 2500:	1500 Mc to 2700 Mc
Type 0 4000:	2600 Mc to 4000 Mc



These UHF oscillators are controlled by the basic synthesizer unit, **Type DO 1001** (frequency range 50 kc to 52 Mc), which permits a setting accuracy of approx. ± 10 cps in continuous tuning, and phase locked increments of 10 kc, over the entire range of 850 Mc to 4000 Mc. The incorporated crystal standard offers a stability of approx. 2parts in 10^8. For higher accuracy requirements, the additional use of a **FS 1 (2)** or **FS 30** is recommended. The crystal stability and setting accuracy of the latter is then transposed and available in the UHF band.

Transistorized VHF/UHF Measuring Equipments:

Type FS 500 Precision Signal Generator 27 Mc to 470 Mc; phase locked at 1 Mc intervals, max. output voltage > 1 volt (50 ohms), **extension unit to FS 1, FS 2, FS 30.**

Type FSM 500 Precision Signal Generator 27 Mc to 470 Mc, phase locked at 1 Mc intervals, continuous tuning accuracy ± 500 cps, max. output voltage > 1 volt (50 ohms), AM/FM, internal. modul. generator 20 cps to 20 kc, variable attenuator max. 140 db, built-in sweep provision, extremely low FM noise.

Type FSM 503 As FSM 500, but better setting accuracy of carrier (27 Mc to 470 Mc): phase locked at 1 kc intervals, continuous tuning ± 5 cps.

Type FSX 3003 Precision Frequency Meter 0 to 3000 Mc; phase locked at 1 kc intervals, continuous tuning: ± 5 cps (in fundamental range 0 to 100 Mc). Signal generator to 100 Mc, max. output voltage > 0.1 volt (50 ohms). Incorporates harmonic mixer < 3000 Mc with additional difference frequency amplifier.

Type FSX 3004 As FSX 3003, but better setting accuracy of carrier: 100 cps phase locked intervals and ± 0.5 cps continuous tuning.

Remote Controlled Transistorized Digital Signal Generators:

Type FS 2 D Precision Generator with remote frequency setting by external contacts (decimal coded) and with a selection time of < 100 millisec. Sweep provision max. 10 Mc variation is provided, as well as 100 selectable crystal markers. Wide temperature range (silicon transistors only). Frequency range 50 cps to 2 Mc, phase locked at 0.01 cps intervals, output 2.5 volts (50 ohms).

Type FS 40 D As Type FS 2 D, except frequency range 300 cps to 40 Mc, phase locked at 0.1 cps intervals, output 2 volts (50 ohms).

Type FS 100 D As Type FS 2 D, except frequency range 10 kc to 100 Mc, phase locked at 0.1 cps intervals, output 1 volt (50 ohms).

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06/06 07 65/E

Printed in Western Germany

Changes without notice!